LEVEL II

(1)

Research Memorandum 78-18

THE MEASUREMENT OF MILITARY STUDENT ATTITUDES TOWARD COMPUTER-ASSISTED INSTRUCTION

Bruce W. Knerr and Leon H. Nawrocki

UNIT TRAINING AND EVALUATION SYSTEMS TECHNICAL AREA

U. S. Army
Research Institute for the Behavioral and Social Sciences

August 1978

(16) 2T161101A91B

Army Project Number
2T161101A91B

Training Technology

(9) memo
Research Memorandum 78-18

(6) THE MEASUREMENT OF MILITARY STUDENT ATTITUDES TOWARD COMPUTER-ASSISTED INSTRUCTION

(10) Bruce W. Knerr and Leon H. Nawrocki

(12) 32

UNIT TRAINING AND EVALUATION SYSTEMS TECHNICAL AREA

(14) ARI-RM-78-18

(11) August 1978

Submitted as complete and
technically accurate, by
Frank J. Harris
Technical Area Chief

Approved by:

A. H. Birnbaum, Acting Director
Organizations & Systems Research
Laboratory

Joseph Zeidner, Technical Director
(Designate)
U.S. Army Research Institute for
the Behavioral and Social Sciences

Accession For	
NTIS GRA&I	X
DDC TAB	
Unannounced	
Justification	
By	
Distribution/	
Availability Codes	
Dist.	Avail and/or special
A	

Research Memorandums are informal reports on technical research problems. Limited distribution is made, primarily to personnel engaged in research for the Army Research Institute.

408 020

THE MEASUREMENT OF MILITARY STUDENT ATTITUDES TOWARD COMPUTER-ASSISTED INSTRUCTION

CONTENTS

LIST OF TABLES

THE MEASUREMENT OF MILITARY STUDENT ATTITUDES TOWARD COMPUTER-ASSISTED INSTRUCTION

Student attitudes toward Programmed Instruction (PI) and Computer-Assisted Instruction (CAI) have long been a topic of interest for researchers and trainers. This interest, however, has produced neither well-integrated nor consistent results. King (1975), in a review of the research in this area, noted two methodological problems that seem at least partially responsible for this lack of integration and consistency. First, although student attitude data are frequently collected (44 studies are cited), student attitudes have not been investigated in any consistent fashion. Only rarely are student attitudes the primary focus of the research. Instead, student attitudes are typically incidental to research or evaluation plans. Second, there is little agreement on an operational definition of student attitude.

There have been some attempts to achieve consistency in the use of measuring instruments: Five of the studies cited by King and one additional study cited here (Gallagher, 1970) have used either Brown's (1966) scale or modifications of it. The instruments used for the most part, however, are designed ad hoc, with neither the items nor the metric properties of the scales described. As King noted, "most studies are experimenter-constructed tests which have unknown or unreported reliabilities (1975, p. 7)."

Very few studies have attempted to investigate what, if any, relationships exist between attitude toward PI or CAI and performance in a course of instruction taught by that method. An early effort (Doty & Doty, 1964) measured undergraduate student attitudes toward a PI unit on physiological psychology following completion of that unit. The attitude measure was described only as consisting of 10 5-point rating scales. Course performance was measured by a 75-item multiple-choice achievement test. The relationship between attitude and achievement was nonsignificant for males and for the total sample but positive and significant for females ($r(48) = .43$, $p < .01$).

Gallagher (1970) investigated the effects of student attitudes in a graduate-level course on the techniques of programed instruction taught by Computer-Managed Instruction (CMI). All subjects were administered the Michigan State University Learning Service "Attitude Toward Learning Inventory" three times during the course. This 28-item Likert scale is described as assessing student attitudes in five categories: Mechanical Comfort-Discomfort, Desire for Teacher Contact, Initiative and Participation in the Learning Process, Independence in Learning (Autonomy), and Ease of Learning. The reliability of the total scale, as measured by the Hoyt method, is .937. However, the subscale scores, rather than the total score, were used in this study.

Following course completion, the students were administered a modified version of Brown's (1966) scale for the measurement of attitudes toward CAI. Both the original and modified 40-item Likert scales were reported by Gallagher to have Kuder-Richardson Formula 20 (KR 20) reliabilities of .89.

Gallagher concluded that "there was a relationship between specific learner characteristics and course success. The students who proved most successful in the course . . . expressed positive attitudes toward CMI (p. ii)." This conclusion was based on the observation that the attitude scales contributed to significant multiple correlations between learner characteristics and performance criteria. On the other hand, there were (a) no significant zero-order correlations between the attitude scale scores and performance criteria and (b) no attitude scale scores contributed significantly to the multiple correlations. Hence, Gallagher's conclusion is questionable, at least on statistical grounds.

Mathis, Smith, and Hansen (1970) administered similar attitude scales to college students before and after they were taught a segment of an introductory psychology course via CAI. The scales used were 30-item modifications of the Brown scale described previously. For one scale, the items were "futurized," i.e., stated as expectations to make the scale appropriate for use as a pretest. No scale reliabilities from this study were presented, but it was noted that 27 of the 30 posttest items previously were found to have a KR 20 reliability of .82. Errors per question attempted were negatively correlated with posttest attitude ($r\ (30) = -.49$, $p < .01$) but were not correlated with pretest attitude.

Reid, Palmer, Whitlock, and Jones (1973) measured attitude toward CAI before and after CAI instruction on scientific notation. Interpretation of this study is difficult because scores on pairs of subjects, rather than individual scores, were used for the analyses. The same attitude scale, with undefined metric properties, was used for both the pretest and the posttest. Performance criteria were achievement test scores and the amount of time required to complete the program. Although no overall relationship between prior attitude and achievement was obtained, significant relationships were found for certain subgroups. The correlation between prior attitude and achievement test score was .40 ($p < .05$) for all female pairs; .46 ($p < .02$) for mixed-sex pairs; nonsignificant overall for all-male pairs; and .66 ($p < .05$) for low-test anxiety, all-male pairs (one of three all-male subgroups). Posttest attitude and performance correlated significantly only for low-test anxiety pairs ($r = .35$, $p < .05$). Attitude change was correlated significantly only with time to completion for mixed-test anxiety, all-male pairs ($r = .90$, $p < .05$). It seems safe to attribute these results to chance alone because among more than 96 correlations, only 5 were found to be significant beyond the .05 level.

Although no definite conclusions can be drawn from this research, the results do suggest that relationships between attitude and performance may exist in some situations. The applicability of this research to military subjects is open to question. All subjects were college or graduate students; with the exception of Gallagher's (1970) study, all courses were short (less than 2 hours).

PURPOSE

The purpose of this study was to extend the research on attitudes toward CAI to the military training situation. The first step involved the development and revision of the necessary attitude scales because existing scales were inappropriate for two reasons.

First, both pretest and posttest versions were required, and existing pretests had not been designed specifically for students with little or no prior experience with CAI.

Second, the reading level required by existing scales was at a higher level than that typically encountered with enlisted military personnel. This report presents the results of the scale development process and results of a preliminary investigation of the relationships between student attitudes and training performance.

Although this effort is a basic research study, it was undertaken to support an operational evaluation. The initial impetus for this project was a request from the U.S. Army Ordnance Center and School (USAOC&S) for scales to measure student attitudes toward CAI for use in their evaluation of the training effectiveness of the PLATO IV CAI system. Attempting to meet their request made the need for basic research in this area apparent. The result was a cooperative effort, with USAOC&S receiving the scales for their use and ARI receiving personnel and student support for the basic research project.

METHOD

Samples

Data were collected in conjunction with the evaluation of the PLATO IV CAI system conducted at the USAOC&S from April 1974 to July 1975. Details of this evaluation are presented elsewhere (USAOC&S, 1975). A total of 320 students in the enlisted Machinist Course (MOS 44E20) completed at least one of the scales. Regular Army, Army Reserve, Air Force, and Marine Corps students were included. Students were divided into five independent samples:

Preliminary. Those students whose data were used for preliminary revision of the pretest (N = 28).

CAI Pretest Only. Those students who received the pretest and subsequently received instruction via CAI but did not receive the posttest (N = 93).

Non-CAI Pretest Only. Those students who received the pretest but did not receive instruction via CAI and did not receive the posttest (N = 135).

CAI Pre-Post. Those students who received both the pretest and the posttest, with intervening instruction via CAI (N = 44).

CAI Posttest Only. Those students who received instruction via CAI and a posttest but no pretest (N = 20).

Classification test scores were available for some students. These included the Armed Forces Qualification Test (AFQT); and the General Technical (GT), General Maintenance (GM), and Mechanical Maintenance (MM) Aptitude Area Scores of the Army Classification Battery.

Initial Item Selection

Pretest. A 17-item pretest (see Appendix A) was developed using items adapted from several sources. Seven items (1, 3, 4, 9, 10, 14, and 16) were revisions of items found in Brown's (1966) scale. Revisions were made to increase clarity of readability and, where required, to rephrase the question in the future tense. Two other items from Brown's scale (7 and 13) required changes in tense only. Four items (6, 8, 11, and 15) were taken unchanged from the Attitude Toward Learning Inventory. Finally, four new items (2, 5, 12, and 17) were written by the authors.

Posttest. The 42 posttest items are shown in Appendix B. The 17 pretest items (26-42) were included in the posttest, rewritten in the past tense where necessary. Twenty-five items were added to gather information about specific aspects of CAI or the courseware. Nine of these items (2, 5, 8, 11, 15, 16, 18, 22, and 23) were taken unchanged from Brown's scale, and 16 (1, 3, 4, 6, 7, 9, 10, 12, 13, 14, 17, 19, 20, 21, 24, and 25) were revisions of items from that scale. In summary, the posttest consisted of 11 original Brown items, 23 revised Brown items, 4 original Attitude Toward Learning items, and 4 new items.

Attitude Aspects Sampled. In the absence of an operational definition of student attitude, the questions included in the initial versions of the scales provided relatively complete coverage of the salient aspects of the students' CAI experience. Revision of the scales to increase internal consistency would then eliminate those aspects that were not related to student attitude (defined as total scale score). Aspects included in the initial versions of the scales were as follows:

1. The extent to which CAI and the instructional process is perceived as being personal and nonmechanical;

2. The perceived ease or difficulty with which the student is able to learn material presented via CAI;

3. The extent to which CAI induces anxiety in the student;

4. The extent to which CAI is perceived as being interesting or boring;

5. The extent to which the student "likes" or "dislikes" CAI;

6. The extent to which the student prefers CAI to other instructional methods;

7. The extent to which the student perceives the feedback provided by CAI as being adequate and helpful;

8. The extent to which the lesson material itself is perceived as being adequate; and

9. The extent to which the student deliberately provides incorrect information in order to obtain additional information.

Procedure

The pretest was administered to the students prior to determining whether they would receive instruction via CAI. The posttest was administered to students when they completed the course. All items were scored on a 5-point scale, with 5 representing the most positive response toward CAI and 1 the least positive.

Two separate sets of analyses, having different objectives, were performed on the data. The objective of the first set was to increase the internal consistency of the scales. The Preliminary sample data were used to perform these analyses on the pretest, and the combined CAI Pre-Post and CAI Posttest Only sample provided the data for the posttest analyses. Inter-item and item-total (r_{it}) correlations were calculated for both the pretest and the posttest and also calculated separately for (a) those 17 items on the posttest that were repeated from the pretest and (b) those 25 items that were unique to the posttest.

In general, the procedure for item elimination was as follows. The Kuder-Richardson Formula 8 (KR 8; Kuder & Richardson, 1937) value

was calculated for the original item set.[1] Items with the lowest r_{it}'s were eliminated first, and KR 8 was recalculated after each step. The process was terminated when further item elimination produced minimal changes in the KR 8 value. For the pretest, the internal consistency of the final version was calculated separately on those 228 students (CAI Pretest Only and Non-CAI Pretest Only samples) whose data were not used in the revision process.

The second set of analyses, conducted to determine the validity of the scales, used the scores on the revised versions of the scales and external variables: classification test scores and the amount of time required to complete four lessons via CAI (lesson completion time). Correlational analyses were conducted to determine (a) the extent to which pretest attitude predicted lesson completion time and (b) the extent to which lesson completion time was related to pre-post attitude change. The CAI Pretest Only and CAI Pre-Post samples were used for the first analysis, and the CAI Pre-Post sample alone for the second.

RESULTS

Pretest Revision

Preliminary sample item means, standard deviations, and item-total correlations for 17 items on the original and revised versions of the scale are presented in Table 1. The KR 8 calculated on the original scale was .8159. Four items (1, 6, 8, and 15) did not correlate significantly with the total score and were removed in the first iteration. The resulting KR 8 was .8546. Items 3, 11, and 17, which had the lowest item-test correlations of the remaining items, were removed one at a time, with KR 8 calculated after each item was removed. Because the results were all within the range .8546 $\pm$ .0069, only the first four items were eliminated.

The method used for scale revision, i.e., the elimination of items with low r_{it}'s, created the possibility that the internal consistency estimates calculated on the Preliminary sample might be spuriously high. Items retained might have shown high r_{it}'s because of chance peculiarities of that sample. Those r_{it}'s, and consequently the internal consistency estimates, might be expected to be lower when calculated on a second sample.

---

[1] This measure entails fewer assumptions than the more commonly used formula 20. Specifically, KR 8 assumes that the intercorrelation matrix has a rank of 1, i.e., that the scale measures only one factor, whereas KR 20 assumes, in addition, that all item intercorrelations and standard deviations are equal. If these conditions are met, KR 8 and KR 20 will produce identical reliability estimates. If they are not met, KR 8 will produce higher and more accurate reliability estimates than KR 20.

Table 1

Means, Standard Deviations, and Item-Total Correlations on the Original and Revised Pretest for the 17-Item Preliminary Sample (N = 28)

Item number	Mean	Standard deviation	Item-test r's[a]	
			Original	Revised
1	2.00	.76	.09	--
2	3.07	.88	.66	.67
3	3.36	.81	.37	.45
4	2.75	1.09	.65	.61
5	2.32	1.14	.58	.60
6	2.86	1.12	-.04	--
7	2.79	1.08	.62	.65
8	4.39	.94	.16	--
9	2.68	1.04	.71	.69
10	2.96	.94	.75	.70
11	2.68	1.07	.41	.43
12	2.04	.78	.49	.54
13	3.00	1.00	.51	.54
14	3.04	1.18	.71	.68
15	4.52[b]	.69[b]	.11	--
16	2.29[b]	.70[b]	.53	.55
17	2.22	1.09	.49	.48

[a] N = 26.

[b] N = 27.

To determine if this was the case, r_{it}'s and KR 8's were calculated on the pooled CAI and Non-CAI Pretest Only samples (N = 228). Means, standard deviations, and r_{it}'s are shown in Table 2; KR 8 values for the original and revised versions of the scale are .8785 and .9088, respectively.

Total scores on the original and revised versions of the pretest are highly related. Their intercorrelation is .9828, reflecting the low r_{it}'s of the items eliminated. The revision process reduced the pretest mean from 56.66 to 42.75 and the variance from 87.93 to 76.84.

Table 2

Means, Standard Deviations, and Item-Total Correlations on the Original and Revised Pretest for the Pooled CAI and Non-CAI Pretest Only Samples (N = 228)

Item number	Mean	Standard item-total N's[b]		
		Standard deviation	Original	Revised
1	2.54	1.14	.13	--
2	3.75	.90	.68	.69
3	3.68	.88	.49	.49
4	3.35	1.12	.65	.66
5	3.12	1.13	.64	.67
6	2.63	1.09	.01	--
7[a]	3.52	.99	.64	.65
8	4.53	.71	.29	--
9	3.51	.91	.73	.74
10	3.17	.89	.71	.73
11[a]	3.10	1.16	.44	.44
12	2.87	1.09	.72	.75
13	3.41	.96	.76	.76
14[b]	3.73	1.14	.58	.57
15	4.23	.96	.42	--
16	2.82	1.02	.72	.75
17	2.70	1.09	.72	.74

[a] N = 227.

[b] N = 224.

Posttest Revision

Because a limited number of students received the posttest, only one sample was used for posttest revision. That sample was formed by pooling the CAI Pre-Post and CAI Posttest Only samples (N = 64).

On the posttest, r_{it}'s and KR 8's were calculated for two subtotals as well as for the total score. Those subtotals were (a) items repeated from the pretest (originally 17), and (b) items unique to the posttest (originally 25). The procedure for eliminating items was the same as was used for the pretest. Those items that had been eliminated from the pretest (posttest items 26, 30, 32, and 40) were the first to be eliminated from the posttest. One additional item (2), unique to the

posttest, was also eliminated. Elimination was terminated at this point because the next items to be eliminated would have been ones that showed high r_{it}'s on the pretest. Means, standard deviations, and item-subtotal and item-total correlations on both the original and revised versions of the posttest are shown in Table 3.

Revision increased internal consistency from .7818 to .8538 on the repeated items, from .7999 to .8145 on the unique items, and from .8675 to .8890 on the total posttest.

As with the pretest, the original and revised versions of the scale were closely related in terms of both total and subtotal scores. The intercorrelation between the original and revised versions of the unique item set was .9960. The revision process reduced the mean from 96.20 to 94.34 and increased the variance from 93.94 to 96.16. The correlation between the two versions of the repeated item set was .9722, with the mean reduced from 65.00 to 50.16 and the variance reduced from 47.91 to 44.29 as a result of revision. For the entire posttest, the correlation between the original and revised versions was .9936. The revision process reduced the mean from 161.20 to 144.50, while increasing the variance from 234.88 to 237.06.

The Predictive Validity of the Pretest

A nine-variable intercorrelation matrix was calculated as the first step in assessing the predictive validity of the pretest and determining the correlates of attitude change. The variables were AFQT score; GM, MM, and GT aptitude area scores; pretest score; unique, repeated, and total posttest scores; and the time required to complete four blocks of instruction. Correlations were based on all available data from the combined CAI Pretest Only and CAI Pre-Post samples. Sample sizes for the individual correlations fluctuated widely because of missing data on many subjects. The intercorrelation matrix, along with means and standard deviations for the nine variables, is presented in Table 4.

Table 4 shows two groups of intercorrelated variables: selection and classification tests (AFQT, GM, GT, and MM) and the attitude scales and subscales (pretest, unique, repeated, and total posttest). Other than the above, the only significant correlation is that between the pretest and AFQT, $r\ (33) = .4077$, $p < .05$. The correlation of interest for the establishment of predictive validity is that between the pretest and lesson completion time. This correlation is clearly nonsignificant ($r\ (68) = -.0265$, $p > .05$).

Table 3

Means, Standard Deviations, Item Subtotal Correlations, and Item-Total Correlations on the Original and Revised Posttest for the Pooled CAI Pre-Post and Posttest Only Samples (N = 64)

Item number	Mean	Standard deviation	Item-subtotal r's[a]		Item-total r's[a]	
			Original	Revised	Original	Revised
1	4.22	.74	.46	.47	.48	.48
2	1.86	.88	-.13	--	.17	--
3[a]	3.95	.68	.23	.24	.25	.25
4	3.41	1.13	.27	.28	.27	.26
5	3.45	.90	.30	.29	.26	.26
6[b]	4.02	.90	.52	.50	.43	.42
7	3.81	1.16	.33	.35	.30	.32
8	3.23	1.04	.26	.25	.20	.22
9[a]	4.26	.82	.50	.51	.48	.49
10	3.69	.97	.36	.36	.36	.36
11	4.31	.95	.41	.41	.29	.30
12[b]	4.62	.84	.42	.41	.33	.34
13	4.12	1.08	.54	.54	.45	.47
14	3.92	1.34	.54	.54	.53	.53
15[b]	4.24	.95	.42	.42	.33	.33
16[a]	3.52	1.09	.47	.48	.46	.43
17[b]	4.22	.83	.60	.59	.54	.53
18	3.94	1.06	.39	.41	.44	.44
19[b]	4.67	.73	.38	.37	.33	.35
20[b]	3.08	1.13	.26	.24	.24	.23
21	4.02	1.12	.21	.21	.23	.24
22	4.41	.84	.33	.34	.35	.34
23	3.91	1.07	.64	.64	.55	.56
24	3.78	1.04	.58	.58	.68	.69
25	3.64	1.07	.51	.51	.61	.62
26	3.52	1.21	.17	--	.18	--
27	4.17	.78	.62	.64	.57	.57
28	4.14	.85	.46	.49	.54	.54
29	3.94	.98	.72	.74	.69	.70
30	3.59	.91	.62	.66	.64	.65
31	2.75	1.20	.08	--	.06	--
32	3.83	1.07	.27	.27	.18	.18
33	4.34	.67	.33	--	.24	--
34	4.28	.76	.67	.68	.69	.68
35	3.69	.90	.49	.51	.51	.52

[a] N = 62.

[b] N = 63.

Table 3 (continued)

Item number	Mean	Standard deviation	Item-subtotal r's[a]		Item-total r's[a]	
			Original	Revised	Original	Revised
36	3.77	1.04	.62	.65	.50	.51
37	3.52	1.00	.59	.61	.55	.56
38	3.98	.72	.57	.61	.47	.48
39[b]	4.21	.95	.45	.41	.41	.40
40[b]	4.24	.95	-.08	--	-.10	--
41[b]	3.57	.97	.81	.80	.69	.68
42[b]	3.44	.87	.25	.28	.17	.17

[a] N = 62.

[b] N = 63.

Table 4

Intercorrelations of Test Scores, Attitude Scale Scores, and Lesson Completion Time, with the Maximum Sample Size, Mean, and Standard Deviation for Each Variable

	AFQT	GM	GT	MM	Pretest	Posttest repeated	Posttest unique	Posttest total	Time
AFQT		.7222** (35)	.7963** (35)	.4748** (35)	.4077* (35)	.1945 (17)	.3142 (17)	.2716 (17)	-.3171 (20)
GM			.6291** (54)	.6940** (44)	.0857 (55)	-.0953 (26)	.1527 (26)	.0533 (26)	-.2402 (31)
GT				.4361** (44)	.2052 (54)	.1201 (26)	.3726 (26)	.2763 (26)	-.2330 (30)
MM					.0672 (44)	-.2614 (21)	-.0727 (21)	-.1630 (21)	-.3066 (25)
Pretest						.3218* (43)	.3197* (43)	.3474* (43)	-.0265 (70)
Posttest repeated							.6952** (43)	.8902** (43)	-.1566 (25)
Posttest unique								.9191** (43)	-.3047 (25)
Posttest total									-.2658 (25)
Maximum N	35	55	54	44	70	43	43	43	70
Mean	57.4857	110.3636	104.3333	113.9091	44.4366	48.9535	92.6977	141.6512	6.2310
Standard deviation	19.1526	9.9587	9.2416	13.9818	7.7028	7.1201	9.9710	15.7567	3.3214

Note: Sample sizes are in parentheses.

**p < .01.
*p < .05.

Correlates of Attitude Change

The results indicate that attitudes toward CAI change over time. In the CAI Pre-Post sample, the mean score on the pretest was 43.81, while the mean score on the repeated portion of the posttest (which contained the same items as the pretest) was 48.95. Using the t test for correlated means, this difference was found to be significant on the .01 level, $t\ (42) = 3.98$.

An attempt was made, therefore, to determine what factors were correlated with this attitude change. The measure of attitude change used was residual change, that is, that portion of the posttest score that is independent of the pretest score. In standard scores residual change, $z_{2.1}$, is defined as

$$z_{2.1} = z_2 - r_{12}\, z_1$$

where

z_2 = posttest score

z_1 = pretest score

r_{12}= correlation between pretest score and posttest score.

Use of residual change in this situation has two advantages over the use of a raw gain score (posttest minus pretest): (a) It is not correlated with pretest score, whereas raw gain is negatively correlated with pretest score; and (b) it does not require that the pretest and posttest scores have the same metric (Manning & DuBois, 1962).

Correlations between residual change and other variables were not calculated directly. The part correlation (McNemar, 1962, p. 167) was used instead. Thus, the correlation calculated was that between an outside variable and the posttest score, with the effects of the pretest "removed" from the posttest score. Three different residual changes were calculated: pretest-unique subtest, pretest-repeated subtest, and pretest-total posttest. The resulting correlations are presented in Table 5.

Table 5 shows only 1 significant correlation of 15 calculated between any of the residuals and the outside variables. This is the correlation between the pretest-unique subtest residual and lesson completion time ($r\ (23) = .4129$, $p < .05$). This correlation indicates that the longer it takes a student to complete the lessons, the greater his or her (negative) deviation from the regression line predicting unique subtest score from pretest score. Given the number of correlations calculated, this result easily could have occurred by chance.

Table 5

Correlation Between Three Types of Residual Change and Outside Variables

Variable	Type of Residual		
	Pretest-repeated	Pretest-unique	Pretest-total
Time	-.1564 (25)	-.4129* (25)	-.2918 (25)
AFQT	.0669 (17)	.2048 (17)	.1478 (17)
GM	-.1298 (26)	.1396 (26)	.0268 (26)
GT	.0571 (26)	.3423 (26)	.2332 (26)
MM	-.2989 (21)	.0121 (21)	-.2119 (21)

Note: Sample sizes are shown in parentheses.

*$p < .05$.

DISCUSSION

Scale Reliabilities

In terms of internal consistency, the scales compare favorably with those developed previously. KR-20[2] reliability estimates are .8904 for the pretest and .8786 for the posttest. Few other scales that could be used as pretests have reported reliabilities. Gallagher (1970) reported an internal consistency of .937 (Hoyt method) for the Attitude Toward Learning Inventory. Although this scale is suitable for use as a pretest, it is not designed specifically to measure attitudes toward CAI. Mathis et al. (1970) developed a 30-item pretest but reported no internal consistency for it.

[2]As previously noted, these estimates are less accurate reliability estimates than those provided by KR 8. Use of KR 20 in this instance does, however, permit comparisons with other scales for which KR-8 estimates are not available.

Internal consistencies (KR 20 or equivalent) for other scales used as posttests are .89 for Brown's (1966) 40-item scale and .82 for the 27-item scale developed by Mathis et al. (1970). Other scales, such as those used by Doty and Doty (1964) and Reid et al. (1973), have no reported internal consistencies.

Pretest Attitude as a Predictor of Performance

It is clear that pretest attitude is ineffective as a predictor of lesson completion time. Two factors should be considered. First, the lessons included an option that permitted the student to take the lesson posttest prior to the instructional component of the lesson. If the student passed that test, he or she was considered to have completed the lesson. Thus, lesson completion time is somewhat confounded by the effects of prior knowledge of the subject matter. Second, lesson completion time is only one aspect of performance in the instructional situation and, judging from previous research, not the most predictable one. Other aspects of performance either were not available (such as errors made during the course of the lesson) or were so invariant as to be useless (end of lesson performance test failures).

Given the limited number of performance measures used, it is perhaps too early to state that attitudes prior to instruction, as measured by the pretest described in this report, do not affect performance. Evidence to date, however, suggests this may be the case.

Correlates of Attitude Change

Student attitudes did change as a result of their experience with CAI. Selection and classification test scores were not correlated significantly with any of the measures of attitude change, indicating that the extent of attitude change was not affected by the students' "abilities." The pretest-unique posttest residual was the only measure of attitude change that was correlated with lesson completion time. This may reflect the fact that the unique posttest items inquire largely about specific aspects of the student's exposure to CAI, whereas the repeated posttest items are more general in nature.

Conclusions

In terms of internal consistency, the scales compare favorably with those previously developed. Students' pretest attitudes did not predict lesson completion time. Whether they predict other measures of training performance is a potential area for future research.

Overall attitude change (pretest-total posttest) was not related to lesson completion time. A negative correlation was obtained, however, between pretest-unique posttest change and the same criterion. Although the evidence is weak, this suggests that student attitudes may be somewhat sensitive to the nature of the student's experience with CAI.

REFERENCES

Brown, B. R. An Instrument for the Measurement of Expressed Attitude Toward Computer-Assisted Instruction. In H. E. Mitzel and G. L. Brandon (Eds.), Experimentation with Computer-Assisted Instruction in Technical Education. Semi-Annual Progress Report, Project No. OEC-5-85-074. University Park, Pa.: The Pennsylvania State University, December 31, 1966.

Doty, B. A., & Doty, L. A. Programmed Instruction Effectiveness in Relation to Certain Student Characteristics. Journal of Educational Psychology, 1964, 55, 334-338.

Gallagher, P. D. An Investigation of Instructional Treatments and Learner Characteristics in a Computer-Managed Instruction Course. Technical Report No. 12, CAI Center, Institute of Human Learning. Tallahassee, Fla.: Florida State University, 1970.

King, A. T. Impact of Computer-Based Instruction on Attitudes of Students and Instructors: A Review (AFHRL-TR-75-4). Air Force Human Resources Laboratory, Technical Training Division, Lowery Air Force Base, Colo.: May 1975.

Kuder, G. F., & Richardson, M. W. The Theory of the Estimation of Test Reliability. Psychometrika, 1937, 2, 151-160.

Manning, W. H., & DuBois, P. H. Correlational Methods in Research on Human Learning. Perceptual and Motor Skills, 1962, 15, 287-321.

Mathis, A., Smith, T., & Hansen, D. College Students' Attitudes Toward Computer-Assisted Instruction. Journal of Educational Psychology, 1970, 61, 46-51.

McNemar, Q. Psychological Statistics (3rd Ed.). New York: Wiley, 1962.

Reid, J. B., Palmer, R. L., Whitlock, J., & Jones, J. Computer-Assisted Instruction Performance of Student Pairs as Related to Individual Differences. Journal of Educational Psychology, 1973, 65, 65-73.

U.S. Army Ordnance Center and School. Evaluation of the PLATO IV System in a Military Training Environment: October 1972-June 1975 (2 vols.). Aberdeen Proving Ground, Md.: Author, 1975.

APPENDIX A

PRETEST QUESTIONNAIRE

Items marked with an asterisk (*) have been eliminated.

*1. When I am trying to learn something, it is important to me to know where I stand in comparison to others.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

2. I would like to take a course taught by CAI.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

3. Taking a course taught by CAI would make me nervous.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

4. Taking a course taught by computer would be more interesting than taking the same course taught in some other way.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

5. People should be taught by other people, not by machines.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

*6. I feel very uncomfortable when others know that I've made a mistake.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

7. I think I would feel isolated and alone while taking a course taught by computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

*8. I like it when I can immediately find out where I have made my mistakes.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

9. It would be boring to take a course taught by computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

10. I think it would be easy to understand the material in a course taught by computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

11. Students are being treated more and more like IBM cards.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

12. How much of this course do you think you would like to have taught by computer?

(a) All of it
(b) 75%
(c) 50%
(d) 25%
(e) None of it

13. Taking a course taught by computer would be too mechanical.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

14. I think I would feel challenged to do my best work while taking a course taught by computer.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

*15. I don't like to have my errors pointed out to me.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

16. I would prefer to have most courses taught by computer rather than by other teaching methods.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

17. Most courses could be taught more effectively by a regular teacher than by computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

APPENDIX B

POSTTEST QUESTIONNAIRE

Items marked with an asterisk (*) have been eliminated.

1. The way the material was presented to me made me feel that no one really cared whether I learned or not.

   (a) Strongly agree
   (b) Agree
   (c) Undecided
   (d) Disagree
   (e) Strongly disagree

*2. I was not concerned when I missed a question because no one was watching me anyway.

   (a) Strongly agree
   (b) Agree
   (c) Undecided
   (d) Disagree
   (e) Strongly disagree

3. The method by which I was told whether I had given a right or wrong answer became boring.

   (a) Strongly agree
   (b) Agree
   (c) Undecided
   (d) Disagree
   (e) Strongly disagree

4. I felt as if someone were engaged in conversation with me.

   (a) All the time
   (b) Most of the time
   (c) Some of the time
   (d) Only occasionally
   (e) Never

5. I was concerned that I might not be understanding the material.

   (a) All the time
   (b) Most of the time
   (c) Some of the time
   (d) Only occasionally
   (e) Never

6. The responses to my answers were appropriate.

   (a) All the time
   (b) Most of the time
   (c) Some of the time
   (d) Only occasionally
   (e) Never

7. I felt uncertain as to my performance compared to the performance of others.

   (a) All the time
   (b) Most of the time
   (c) Some of the time
   (d) Only occasionally
   (e) Never

8. I knew whether my answers were correct or not before I was told.

   (a) Quite often
   (b) Often
   (c) Occasionally
   (d) Seldom
   (e) Very seldom

9. I found myself just trying to get through the lesson rather than trying to learn.

   (a) All the time
   (b) Most of the time
   (c) Some of the time
   (d) Only occasionally
   (e) Never

10. I was encouraged by the responses given to my answers.

   (a) All the time
   (b) Most of the time
   (c) Some of the time
   (d) Only occasionally
   (e) Never

11. I guessed at the answers to questions.

   (a) Quite often
   (b) Often
   (c) Occasionally
   (d) Seldom
   (e) Very seldom

12. I was able to work at my own pace.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

13. In view of the time allowed, I felt too much material was presented.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

14. I felt as if I had a private instructor.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

15. I was more involved in running the machine than in understanding the material.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

16. I was aware of efforts to suit the material specifically to me.

(a) Quite often
(b) Often
(c) Occasionally
(d) Seldom
(e) Very seldom

17. I found it difficult to concentrate on the course material because of the machine.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

18. Computer-assisted instruction made it possible for me to learn quickly.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

19. Questions were asked which were not relevant to the material presented.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

20. The responses to my answers seemed to take into account the difficulty of the question.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

21. In order to get more information from the machine, I gave answers which I knew were wrong.

(a) Quite often
(b) Often
(c) Occasionally
(d) Seldom
(e) Very seldom

22. In view of the effort I put into it, I was satisfied with what I learned while taking CAI.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

23. I was given answers but still did not understand the questions.

(a) Quite often
(b) Often
(c) Occasionally
(d) Seldom
(e) Very seldom

24. Based upon my experience with this course, I prefer CAI to other methods of instruction.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

25. In view of the amount I learned, I would say that CAI is superior to other teaching methods.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

*26. When I am trying to learn something, it is important to me to know where I stand in comparison to others.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

27. I would like to take another course which uses CAI.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

28. Taking course work taught by CAI made me nervous.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

29. The material taught by computer was more interesting than taking similar material taught in some other way.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

*30. People should be taught by other people, not by machines.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

31. I feel very uncomfortable when others know that I've made a mistake.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

*32. I felt isolated and alone while working with the computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

33. I liked it when I was able to find out where I had made my mistakes.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

34. It was boring to learn material taught by computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

35. It was easy to understand the material taught by computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

36. Students are being treated more and more like IBM cards.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

37. How much of the course you just completed do you think should be taught by computer?

(a) All of it
(b) 75%
(c) 50%
(d) 25%
(e) None of it

38. Courses taught by computer were too mechanical.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

39. I felt challenged to do my best work while being taught by computer.

(a) All the time
(b) Most of the time
(c) Some of the time
(d) Only occasionally
(e) Never

*40. I don't like to have my errors pointed out to me.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

41. I would prefer to have most courses taught by computer rather than by other teaching methods.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree

42. Most courses could be taught more effectively by a regular teacher than by computer.

(a) Strongly agree
(b) Agree
(c) Undecided
(d) Disagree
(e) Strongly disagree